

U.S. Application Serial No.: 10/666,564
Supplemental Amendment Dated November 3, 2006
In further response to Office Action dated June 30, 2006

Amendments to the Drawings:

The Drawings were amended as follows:

- (1) Hard mask layer 2131 was added to Figs. 2e, 2f, 2g, and 2h, 3a, 3b, and 4a and 4b;
- (2) Holes through layer 2160 and 2131 transferred from stencil were added to Figs. 2g and 2h, as described on page 29, lines 8-12 and "pinched off" as described on page 30, lines 21-26;
- (3) Metal cap 2180, cap layer 2160 and hard mask 2131 were labeled clearly in Figs. 3a and 3b;
- (4) Hard mask 2131 with holes transferred from stencil 2170 was labeled clearly in Fig. 4a and cap layer 2160 and hard mask 2131 with holes closed off was labeled clearly in Fig. 4b.

Replacement sheets containing amended Figs. 2e, 2f, 2g, 2h, 3a, 3b, 4a and 4b are enclosed (pages numbered as 4/7, 5/7, 6/7, and 7/7).

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REMARKS

Claims 1-2, 5-12, and 34-35 are in this application.

Claims 1-2, 5, 7-12, and 34 are pending in this application.

Claims 1 and 7-12 are currently amended.

The Office Action had objected to the Drawings broadly stating that the Drawings must show all the features specified in the claims without indicating any specific feature that is claimed but not shown in the Drawings.

In the Response dated October 2, 2006, Applicants had requested that the Office Action point out any specific feature that is claimed but not shown in the Drawings so that they could be amended to correct the alleged deficiency.

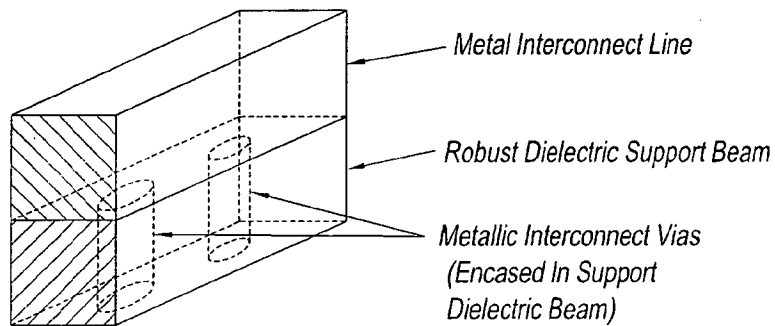
Applicants have reviewed the claims and the Drawings and have amended the claims as well as the Drawings to more particularly define the instant invention.

Replacement Sheets 5/7, 6/7 and 7/7 are containing the amended Figures are enclosed herewith.

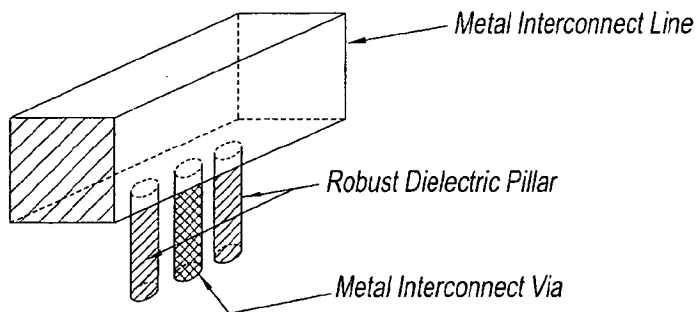
In addition, Applicants enclose the following Perspective Drawing to clarify the difference between the interconnect structures of the instant invention and the prior art:

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Perspective Drawing To Clarify The Difference
Between Prior Art And Structures.



(Prior Art)



(This Application)

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The Drawings were amended as follows:

A hard mask layer 2131 was added to Figs. 2e, 2f, 2g, and 2h, 3a, 3b, and 4a and 4b. Support for layer 2131 is found on page 27, lines 4-9, which states:

“Next, an optional hard mask layer 2131 can be deposited on top of the line level sacrificial dielectric 2130 for the purpose of pattern definition and transfer through the lithography and etch steps. The hard mask layer can also act as a CMP stop. The hard mask is typically an amorphous hydrogenated film of silicon oxide, silicon nitride, silicon carbide, silicon carbonitride, silicon oxycarbide, tantalum nitride and a combination thereof.”

Holes through layer 2160 and 2131 transferred from stencil were added to Figs. 2g and 2h, as described on page 29, lines 8-12 and “pinched off” as described on page 30, lines 21-26.

Support for holes through layer 2160 and 2131 added to Figs. 2g and 2h is found on page 29, lines 8-12, which states:

“Referring to Fig. 2g, the columnar hole pattern is subsequently transferred through the barrier layer and the optional hard mask using a reactive ion etch (RIE) process and the sacrificial dielectrics 2110 and 2130 are extracted. The stencil 2170 can either be a permanent part of the structure, or be sacrificial, as shown in Fig. 2g.”

Support for closed holes over the air gap in layer 2160 (closed) and hard mask 2131 (not filled) and “pinched off” is described on page 30, lines 21-26, which states:

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“Referring to Fig. 2h, following the extraction of the sacrificial dielectric, the holes in the cap layer are pinched off by a thin non-conformal dielectric barrier film preferably made out of the same material as that of layer 2160 followed by the application of the next level sacrificial dielectric so that the whole process can be repeated to yield a multi-level air gap structure as shown in Fig. 2h.”

Thus, the present amendment of Fig. 2g does not add new matter.

Claims 1 was amended to define that the cap layer comprises an array of pinched off holes (see page 30, lines 21-26 for support for “pinched off”).

Claims 7, 10, 11 and 12 were amended to change “or” to “and.”

Claims 8, 9, and 11 were amended to add “sacrificial” before “stencil.”

Claim 8 was further amended to add the word “closed” before “holes” in the paragraph “said cap layer comprising an array of closed holes, there being a plurality of said holes disposed over said air gap.”

Claims 9, 11 and 12 were amended to define that the optional hard mask layer and the cap layer comprise an array of closed holes, and that there are a plurality of such holes disposed over the air gap.

The claims are directed to interconnect structures having robust dielectric pillars. Support for interconnect structures having robust dielectric pillars is found on page 25, lines 9-22, and on page 27, lines 11-18 where such support is described.

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The interconnect structures according to the present invention has discrete dielectric pillars supporting the lines so that the air gap is not only situated between the lines laterally but also in a substantial portion of the region below the lines, as depicted herein above in the Perspective Drawing which shows the difference between the interconnect structures of the instant invention and those of the prior art.

Claims 1, 2, 5-12, 34 and 35 are rejected under 35 USC §103(a) as being unpatentable over (1) Cotte et al. (U.S. Patent No. 6,346,486); (2) Grill et al. (U.S. Patent No. 6,413,852); or (3) Grill et al. (U.S. Patent No. 6,737,725).

None of the references cited by the Office Action teach or suggest the currently pending claims 1-2, 5, 7-12, and 34 which define that the claimed structure has **discrete dielectric pillars** (rather than beams as in all of the cited art) supporting the lines so that the air gap is not only situated between the lines **laterally** but **also in a substantial portion of the region below the lines**.

These features are neither taught nor suggested by either Grill et al. (U.S. Patent No. 6,413,852), Grill et al. (U.S. Patent No. 6,737,725) or Cotte et al. (U.S. Patent No. 6,346,486).

Thus, none of the cited art teaches or suggests the structures defined by amended claims 1-2, 5, 7-12, and 34. Therefore, 1-2, 5, 7-12, and 34 are not obvious over the cited art and, as such, claims 1-2, 5, 7-12, and 34 are allowable.

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Claims 7-12 are rejected under 35 USC §112, second paragraph, as being indefinite. The Office Action states:

"In claims 7-12, it is unclear and confusing to what is meant by and what shows the claimed structures in claims 7-12 as they apply to the elected species of figures 2a-2f. Where are the claimed structure detailed to show on the elected species?"

Applicants respectfully request clarification regarding what is the basis of the rejection, what specific deficiency is being alleged, and what is being specifically requested to correct the alleged deficiency.

In view of the foregoing, Applicants respectfully request reexamination of this application and allowance of the pending claims, namely claims 1-2, 5, 7-12, and 34.

Respectfully submitted,

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